

NASA Facts

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Space Shuttle

Operating the World's Most Versatile Launch System

The United States developed the Space Shuttle system to improve its access to space. Since the first flight in April 1981, the Shuttle has carried more than 2.8 million pounds of cargo and 253 different people into space. The Shuttle is the first and only reusable space vehicle, and is the world's most reliable and versatile launch system. The Shuttle can be configured to carry many different types of equipment, spacecraft and scientific experiments. In addition to transporting people, materials, equipment and spacecraft to orbit, the Shuttle allows astronauts to service and repair satellites and observatories in space, as was demonstrated with the successful repair of the Hubble Space Telescope in December 1999.

Shuttle accomplishments through February 2000:

- 97 missions flown to date
- 834 days of flight time accumulated by the fleet
- 576 total crew members flown:
 - 493 male (220 different individuals)
 - 83 female (33 different individuals)
- 13.8 years of total person time in space onboard Space Shuttle
- More than 2.8 million pounds of cargo have been launched into space, including almost 1 million pounds of payload deployed and left in orbit.

Payloads carried on the Space Shuttle serve diverse missions, including:

- Astronomy
- Microgravity Science
- Astrophysics
- Planetary Science
- Atmospheric Science
- Communications
- Geophysics
- Solar Physics

- Life Science
- National Security
- Materials Science
- International Space Station construction

Shuttle Facts

The Space Shuttle has three major components:

- The Orbiter, which carries the crew, typically five to seven people, and the payload in its 60-foot-long cargo bay, as well as three Space Shuttle Main Engines.
- The 154-foot tall external fuel tank, which stores nearly one-half million gallons of liquid hydrogen and liquid oxygen propellants.
- Twin 150-foot-tall solid rocket boosters, which are strapped to the external tank. Together the boosters generate over 6 million pounds of thrust at liftoff and are jettisoned 2 minutes into the flight. They are recovered and reused.

The three Shuttle main engines produce nearly 1 million pounds of thrust and operate about 8 1/2 minutes from liftoff until the Shuttle achieves low-Earth orbit. The external tank is jettisoned and burns up in the Earth's atmosphere.

There are four Space Shuttles:

Columbia, Discovery, Atlantis, and Endeavour.

Recent and Future Shuttle Missions

The primary objective of the Shuttle is to support NASA launch requirements safely and successfully. Because of its unique and well-established capabilities, the Shuttle remains a key element of America's space program. Shuttle flights will operate well into the 21st century at about seven or eight missions a year.

STS-103

In December 1999, NASA astronauts aboard Space Shuttle *Discovery* performed four spacewalks to re-establish the health of the Hubble Space Telescope, the first of NASA's Great Observatories. During the first spacewalk, the astronauts replaced Hubble's gyroscopes, the primary objective of the mission. The gyroscopes are used to sense Hubble's motion so that the ultra-precise pointing system can control the observatory's orientation and line of site. Spacewalking astronauts also replaced the telescope's computer, transmitter and Fine Guidance Sensor.

Hubble has made great contributions to the field of astronomy, including taking the deepest views ever made of the visible universe dating back to within a billion years of the Big Bang. The telescope also helped astronomers realize that the universe may be destined to expand forever and may even be accelerating.

STS-99

As part of the Shuttle Radar Topography Mission, a crew of six astronauts aboard Space Shuttle Endeavour mapped more than 47.6 million square miles of Earth in February 2000. The mission relied upon a technique known as single-pass interferometry to acquire two images at the same time. Combining both radar image—one from the payload bay antenna and one from the end of a 200-foot mast—will produce a single 3-D image. The data, which would fill more than 20,000 CD's, will be used to produce global maps much more accurate than any available today.

Uses of the data include improved water drainage modeling, more realistic flight simulators, better locations for cell phone towers, navigation safety, and even improved maps for backpackers. Just about any project that requires accurate knowledge of the shape and height of the land can benefit from this data. Some examples are flood control, soil conservation, reforestation, volcano monitoring, earthquake research, and glacier movement monitoring.

STS-101, 106, 92, 97

During 2000, these flights are scheduled to continue assembly of the International Space Station. Assembling a world-class orbiting laboratory that began in November 1998 and is scheduled to conclude in the 2005-2006 timeframe, the Space Shuttle and two types of Russian rockets will conduct 45 missions to launch and assemble more than 100 elements that will comprise the completed International Space Station. In all, 460 tons of structures, modules, equipment and supplies will be placed in orbit.

The International Space Station will serve as a permanent scientific laboratory in space, allowing scientists to perform

experiments in a variety of areas, including combustion, physics, materials, biotechnology, medicine, and health care, as well as Earth and space sciences.

Budget

The Shuttle program is funded under the Human Space Flight portion of NASA's budget.

For fiscal year 2000, the Shuttle budget is \$2.98 billion.

NASA has significantly improved the efficiency of the Shuttle program, reducing annual operating costs without compromising safety since fiscal year 1992.

On October 1, 1996, NASA began a new era in the Space Shuttle program by consolidating some of the ground processing and in-flight operations of the Shuttle under a simplified contract signed with a single company, United Space Alliance (USA). Consolidation of the first-phase operation contracts into the Space Flight Operations Contract were completed in fiscal year 1998, and the first production contract, the solid rocket booster contract, was transitioned in fiscal year 1999. The single prime contract is expected to reduce the cost of flying the Space Shuttle, while maintaining safety.

Space Shuttle safety upgrades are a significant Office of Space Flight budget initiative. NASA's proposed fiscal year 2001 budget provides \$1.9 billion in a safety allocation for safety investments from fiscal year 2001 to 2005, a \$1.4 billion increase over the \$100 million per year that was included in last year's budget for upgrades.

In fiscal year 2000, NASA funded two high priority safety upgrades, the electric Auxiliary Power Unit and the Space Shuttle Main Engine Health Monitoring System. Auxiliary Power Units are generators that power the Shuttle's hydraulics. Today, those generators use a highly volatile and toxic rocket fuel. However, recent advances in battery and electrical power technology—much of it developed by the automotive industry—will replace that system by 2005, eliminating many hazards not only in flight but also on the ground.

The Health Monitoring System will provide a high-tech optical and vibration sensor system and computing power in the engines that will "see" trouble coming a fraction of a second before it can do harm. The sensors will detect and track an almost microscopic flaw in an engine's performance in a split second, allowing the engine to be safely shut down before the situation can grow out of control.

Partnerships

Industry—The Shuttle program has flown many payloads in cooperation with other Government agencies and private industries. Among the payloads flown on the Shuttle are:

- Telecommunications satellites
- Spacecraft that study Earth and monitor global air pollution
- Crystal growth facilities, which produce crystals used for designing drugs
- Cellular and biological research payloads, which have direct application to problems associated with cellular, muscle, and bone deterioration on Earth

International—The Shuttle has flown payloads and astronauts from many different countries:

- Australia
- Italy
- Belgium
- Mexico
- Canada
- The Netherlands
- Germany
- Russia
- Japan
- Saudi Arabia
- France
- Switzerland
- India
- Spain
- Indonesia
- United Kingdom